COURSE CONTENTS & SYLLABUS

(Effective from the Academic Year 2025-2026)

UG – MICROBIOLOGY

(I and II Semester)

National Education Policy (NEP) - 2020

DEPARTMENT OF MICROBIOLOGY
HEMVATI NANDAN BAHUGUNA GARHWAL UNIVERSITY
(A CENTRAL UNIVERSITY)
Srinagar, Garhwal – 246174, Uttarakhand, INDIA

DEPARTMENT OF MICROBIOLOGY

Four Year Undergraduate Program (FYUP)

Syllabus: I & II semester for Microbiology

Credit Framework

Papers to be offered by the department (Microbiology department)

B.Sc. Microbiology (Semester I)				
FYUP Semester	Course Category	Paper Name	Credits T	P
I	DSC Subject-I (Major)	Introduction to Microbiology	2	2
	DSC Subject-II (Minor)	Fundamentals of Microbiology	2	2
	MD/ID (Subject-1)	Basic Microbiology	2	2
	MD/ID (Subject-2)	MD/ID-I	2	2
	SEC/ AEC	SEC I - Microbiological Analysis of Air and Water. **OR** Field work/SEC/Communication Skills/ **OR** AMSC/Field Work/SEC	2	-
	VAC	Understanding and Connecting with Environment **OR** Life Skills & Personality development	2	-
		Total credits	**12+8=20**	
Important Note- **1. SEC I can be opted by students/offered by the dept. in either I or III semesters.** **2. MD/ID Subject-2, AEC and VAC papers will be taught by other departments**				
B.Sc. Microbiology (Semester II)				
II	DSC Subject-I (Major)	Microbiological Techniques	2	2
	DSC Subject-II (Minor)	Methods in Microbiology	2	2
	MD/ID (Subject-1)	Techniques in Microbiology	2	2
	MD/ID (Subject-2)	MD/ID-II	2	2
	SEC/ AEC	SEC II - Microbial Diagnosis in Health Clinics **OR** AMSC/Field Work/SEC **OR** Field work/ SEC/ Communication Skills	2	-
	VAC	Understanding and Connecting with Environment **OR** Life Skills & Personality Development	2	-
		Total credits	**12+8=20**	
Important Note- **1. SEC II can be opted by students/offered by the dept. in either II or IV semesters.** **2. MD/ID Subject-2, AEC and VAC papers will be taught by other departments**				

Semester- I

Microbiology- **DSC Subject-I (MAJOR)**

Name of paper: **Introduction to Microbiology**

TOTAL HOURS: 30 **CREDITS: 02**

Unit I: History of Microbiology **No. of Hours: 08**

Discovery of microorganisms; Spontaneous generation vs. biogenesis; Contributions of Anton von Leeuwenhoek, Louis Pasteur, Robert Koch, Joseph Lister, Martinus W. Beijerinck, N. Winogradsky, Alexander Fleming, Selman A. Waksman, Paul Ehrlich, Elie Metchnikoff, Edward Jenner, Ross; Golden era of microbiology.

Unit II: Classification **No. of Hours: 08**

Kingdom classification of microorganisms: Haeckel's three kingdom concept, Whittaker's five kingdom concept, Six kingdom classification, Eight kingdom classification, Three domain concept of Carl Woese.

Unit III: Cellular Microorganisms **No. of Hours: 07**

Bacteria: Morphology of bacteria, Structure and functions of cell wall, cell membrane, flagella, pili, ribosome, nucleoid, and endospore; Fungi: General and unique characteristics.

Unit IV: Acellular Microorganisms **No. of Hours: 07**

Characteristic features of viruses, prions and bacteriophage; Ultrastructure: Capsids, Types of envelope, Types and structure of genome; Cultivation of viruses and bacteriophage; Multiplication of viruses; Lytic and lysogeny cycle.

Microbiology- **DSC Subject-I (MAJOR) Practical**

Name of paper: **Introduction to Microbiology (Practical)**

TOTAL HOURS: 60 **CREDITS: 02**

1. Safety rules of working in microbiology lab.
2. Study of principle and applications of important instruments (autoclave, laminar air flow, hot air oven, microscope, incubator, inoculator, colony counter and vortex) used in microbiology laboratory.
3. Demonstration of spontaneous generation vs theory of biogenesis.

Suggested Readings

- Wiley, J.M., Sherwood, L.M. and Woolverton, C.J. Prescott, Harley and Klein's microbiology. McGraw-Hill, New York.
- Black, J.G. Microbiology: Principles and exploration. John Wiley and Sons, New Jersey.
- Pelczar, M.J., Chan, E.C.S. and Kreig, N.R. Microbiology. McGraw-Hill, New York.
- Dubey, R.C. and Maheshwari, D.K. A text book of Microbiology. S Chand Publication. New Delhi.
- Prescott, L.M. and Harley, J.P. Laboratory exercises in microbiology. William
- Aneja, K.R. Experiments in microbiology, plant pathology and biotechnology. New Age International (P) Limited, New Delhi.

Semester- I

Microbiology- **DSC Subject-II (MINOR)**

Name of paper: **Fundamentals of Microbiology**

TOTAL HOURS: 30 **CREDITS: 02**

Unit I: History of Microbiology **No. of Hours: 08**

Discovery of microorganisms; Spontaneous generation vs. biogenesis; Contributions of Anton von Leeuwenhoek, Louis Pasteur, Robert Koch, Joseph Lister, Martinus W. Beijerinck, N. Winogradsky, Alexander Fleming, Selman A. Waksman, Paul Ehrlich, Elie Metchnikoff, Edward Jenner, Ross; Golden era of microbiology.

Unit II: Classification **No. of Hours: 08**

Kingdom classification of microorganisms: Haeckel's three kingdom concept, Whittaker's five kingdom concept, Six kingdom classification, Eight kingdom classification, Three domain concept of Carl Woese.

Unit III: Cellular Microorganisms **No. of Hours: 07**

Bacteria: Morphology of bacteria, Structure and functions of cell wall, cell membrane, flagella, pili, ribosome, nucleoid, and endospore; Fungi: General and unique characteristics.

Unit IV: Acellular Microorganisms **No. of Hours: 07**

Characteristic features of viruses, prions and bacteriophage; Ultrastructure: Capsids, Types of envelope, Types and structure of genome; Cultivation of viruses and bacteriophage; Multiplication of viruses; Lytic and lysogeny cycle.

Microbiology- **DSC Subject-II (MINOR) Practical**

Name of paper: **Fundamentals of Microbiology (Practical)**

TOTAL HOURS: 60 **CREDITS: 02**

1. Safety rules of working in microbiology lab.
2. Study of principle and applications of important instruments (autoclave, laminar air flow, hot air oven, microscope, incubator, inoculator, colony counter and vortex) used in microbiology laboratory.
3. Demonstration of spontaneous generation vs theory of biogenesis.

Suggested Readings

- Wiley, J.M., Sherwood, L.M. and Woolverton, C.J. Prescott, Harley and Klein's microbiology. McGraw-Hill, New York.
- Black, J.G. Microbiology: Principles and exploration. John Wiley and Sons, New Jersey.
- Pelczar, M.J., Chan, E.C.S. and Kreig, N.R. Microbiology. McGraw-Hill, New York.
- Dubey, R.C. and Maheshwari, D.K. A text book of Microbiology. S Chand Publication. New Delhi.
- Prescott, L.M. and Harley, J.P. Laboratory exercises in microbiology. William
- Aneja, K.R. Experiments in microbiology, plant pathology and biotechnology. New Age International (P) Limited, New Delhi.

Semester- I

Microbiology- **MD/ ID (Subject-1)**

Name of paper: **Basic Microbiology**

TOTAL HOURS: 30 **CREDITS: 02**

Unit I: History of Microbiology **No. of Hours: 08**

Discovery of microorganisms; Spontaneous generation vs. biogenesis; Contributions of Anton von Leeuwenhoek, Louis Pasteur, Robert Koch, Joseph Lister, Martinus W. Beijerinck, N. Winogradsky, Alexander Fleming, Selman A. Waksman, Paul Ehrlich, Elie Metchnikoff, Edward Jenner, Ross; Golden era of microbiology.

Unit II: Classification **No. of Hours: 08**

Kingdom classification of microorganisms: Haeckel's three kingdom concept, Whittaker's five kingdom concept, Six kingdom classification, Eight kingdom classification, Three domain concept of Carl Woese.

Unit III: Cellular Microorganisms **No. of Hours: 07**

Bacteria: Morphology of bacteria, Structure and functions of cell wall, cell membrane, flagella, pili, ribosome, nucleoid, and endospore; Fungi: General and unique characteristics.

Unit IV: Acellular Microorganisms **No. of Hours: 07**

Characteristic features of viruses, prions and bacteriophage; Ultrastructure: Capsids, Types of envelope, Types and structure of genome; Cultivation of viruses and bacteriophage; Multiplication of viruses; Lytic and lysogeny cycle.

Microbiology- **MD/ ID (Practical)**

Name of paper: **Basic Microbiology (Practical)**

TOTAL HOURS: 60 **CREDITS: 02**

1. Safety rules of working in microbiology lab.
2. Study of principle and applications of important instruments (autoclave, laminar air flow, hot air oven, microscope, incubator, inoculator, colony counter and vortex) used in microbiology laboratory.
3. Staining of Microbial cell.

Suggested Readings

1. Wiley, J.M., Sherwood, L.M. and Woolverton, C.J. Prescott, Harley and Klein's microbiology. McGraw-Hill, New York.
2. Black, J.G. Microbiology: Principles and exploration. John Wiley and Sons, New Jersey.
3. Pelczar, M.J., Chan, E.C.S. and Kreig, N.R. Microbiology. McGraw-Hill, New York.
4. Dubey, R.C. and Maheshwari, D.K. A text book of Microbiology. S Chand Publication. New Delhi.
5. Prescott, L.M. and Harley, J.P. Laboratory exercises in microbiology. William
6. Aneja, K.R. Experiments in microbiology, plant pathology and biotechnology. New Age International (P) Limited, New Delhi.

SEC I: MICROBIOLOGICAL ANALYSIS OF AIR AND WATER

TOTAL HOURS: 30 CREDITS: 02

Unit I: Aeromicrobiology **No. of Hours: 06**

Bioaerosols; Air borne microorganisms (Bacteria, viruses and fungi) and their impact on human health and environment; Significance in food and pharma industries and operation theatres; Allergens.

Unit II: Collection and Analysis of Air Sample **No. of Hours: 08**

Bioaerosol sampling; Air samplers; Methods of sampling and analysis; Culture media for bacteria and fungi; Identification characteristics.

Unit III: Water Microbiology **No. of Hours: 06**

Water-borne pathogens; Water-borne diseases.

Unit IV: Microbiological Analysis of Water **No. of Hours: 10**

Sample collection, Treatment and safety of drinking (potable) water, Water purification, Methods to detect potability of water samples: (a) Standard qualitative procedure (MPN test) (b) Membrane filter technique and (c) Presence/absence tests.

Suggested Readings

1. Da Silva, N., Taniwaki, M.H., Junqueira, V.C., Silveira, N., Nascimento, M.S., Gomes, R.A.R.
2. Microbiological examination methods of food and water: A laboratory manual. CRC Press, Boca Raton.
3. Atlas, R.M. and Bartha, R. Microbial ecology: Fundamentals and applications.
4. Benjamin/Cummings Science Publishing, USA.
5. Madigan, M.T., Martinko, J.M. and Parker, J. Brock biology of microorganisms. Prentice Hall, New Jersey.
6. Mitchell, R. and Gu, J.D. Environmental microbiology. Wiley-Blackwell, New Jersey.
7. Maier, R., Pepper, I. and Gerba, C. Environmental microbiology. Academic Press, San Diego.
8. Evans, G.M. and John, J.C.F. Environmental biotechnology: Theory and applications. John Wiley and Sons, New York.
9. Hurst, C.J., Crawford, R.L., Garland, J.L., Lipson, D.A., Mills, A.L. and Stetzenbach, L.D. Manual of environmental microbiology. ASM Press, Washington, D.C.

Semester- II

Microbiology- **DSC Subject-I (MAJOR)**

Name of paper: **Microbiological Techniques**

TOTAL HOURS: 30 CREDITS: 02

Unit I: Concept of Sterilization **No. of Hours: 08**

Definition of sterilization, dry and moist heat, pasteurization, tyndalization; radiation, ultrasonication, filtration. Physical and Chemical methods of sterilization; disinfection sanitization, antisepsis sterilants and fumigation.

Unit II: Media and Pure Culture Techniques **No. of Hours: 08**

Culture media: basic composition, Solid and liquid media, Synthetic and complex media, Enriched and enrichment media, Selective and differential media; isolation and culture of microbes, inoculation and incubation and maintenance of cultures and related instruments. Pure culture techniques (Pour plate, Spreading, Streaking and serial dilution);

Unit III: Microscopy and Spectroscopy **No. of Hours: 07**

Concept of magnification, resolution and contrast in microscopy, Introduction to Microscope, Principle, types and application of Light and Electron Microscopy, Foldscope, Beer-Lambart law and its application in Spectrophotometry.

Unit IV: Stains and staining techniques **No. of Hours: 07**

Theories of staining, Mechanism of gram staining; Stain vs dye, Principle and applications of staining techniques: simple stain, differential stain, negative stain, endospore stain, and acid-fast stain.

Semester- II

Microbiology- **DSC Subject-I (MAJOR) Practical**

Name of paper: **Microbiological Techniques (PRACTICAL)**

TOTAL HOURS: 60 CREDITS: 02

1. Demonstration of autoclaving process
2. Preparation of solid and liquid media.
3. Enumeration of total viable count in water/soil sample.
4. Isolation of pure culture of bacteria.
5. Gram staining of bacterial cell.
6. Demonstration of working of UV-Visible spectrophotometer

Suggested Readings

- Wiley, J.M., Sherwood, L.M. and Woolverton, C.J. Prescott, Harley and Klein's microbiology. McGraw-Hill, New York.
- Keith Wilson And John Walker (Editors) Principles and Techniques of Biochemistry and Molecular Biology Seventh edition. Cambridge University Press.
- Pelczar, M.J., Chan, E.C.S. and Kreig, N.R. Microbiology. McGraw-Hill, New York.
- Cappucino, J. and Sherman, N. Microbiology: A laboratory manual. Benjamin/Cummings Publishing Company, San Francisco.

Semester- II

Microbiology- **DSC Subject-II (MINOR)**
Name of paper: **Methods in Microbiology**

TOTAL HOURS: 30 **CREDITS: 02**

Unit I: Concept of Sterilization **No. of Hours: 08**
Definition of sterilization, dry and moist heat, pasteurization, tyndalization; radiation, ultrasonication, filtration. Physical and Chemical methods of sterilization; disinfection sanitization, antisepsis sterilants and fumigation.

Unit II: Media and Pure Culture Techniques **No. of Hours: 08**
Culture media: basic composition, Solid and liquid media, Synthetic and complex media, Enriched and enrichment media, Selective and differential media; isolation and culture of microbes, inoculation and incubation and maintenance of cultures and related instruments. Pure culture techniques (Pour plate, Spreading, Streaking and serial dilution);

Unit III: Microscopy and Spectroscopy **No. of Hours: 07**
Concept of magnification, resolution and contrast in microscopy, Introduction to Microscope, Principle, types and application of Light and Electron Microscopy, Foldscope, Beer-Lambart law and its application in Spectrophotometry.

Unit IV: Stains and staining techniques **No. of Hours: 07**
Theories of staining, Mechanism of gram staining; Stain vs dye, Principle and applications of staining techniques: simple stain, differential stain, negative stain, endospore stain, and acid-fast stain.

Semester- II

Microbiology- **DSC Subject-I (MINOR)- Practical**
Name of paper: **Methods in Microbiology (Practical)**

TOTAL HOURS: 60 **CREDITS: 02**

1. Demonstration of autoclaving process
2. Preparation of solid and liquid media.
3. Enumeration of total viable count in water/soil sample.
4. Isolation of pure culture of bacteria.
5. Gram staining of bacterial cell.
6. Demonstration of working of UV-Visible spectrophotometer

Suggested Readings

- Wiley, J.M., Sherwood, L.M. and Woolverton, C.J. Prescott, Harley and Klein's microbiology. McGraw-Hill, New York.
- Keith Wilson And John Walker (Editors) Principles and Techniques of Biochemistry and Molecular Biology Seventh edition. Cambridge University Press.
- Pelczar, M.J., Chan, E.C.S. and Kreig, N.R. Microbiology. McGraw-Hill, New York.
- Cappucino, J. and Sherman, N. Microbiology: A laboratory manual. Benjamin/Cummings Publishing Company, San Francisco.

Microbiology- **MD/ID (Subject-1)**
Name of paper: **Techniques in Microbiology**

TOTAL HOURS: 30 **CREDITS: 02**

Unit I: Concept of Sterilization **No. of Hours: 08**

Definition of sterilization, dry and moist heat, pasteurization, tyndalization; radiation, ultrasonication, filtration. Physical and Chemical methods of sterilization; disinfection sanitization, antisepsis sterilants and fumigation.

Unit II: Media and Pure Culture Techniques **No. of Hours: 08**

Culture media: basic composition, Solid and liquid media, Synthetic and complex media, Enriched and enrichment media, Selective and differential media; isolation and culture of microbes, inoculation and incubation and maintenance of cultures and related instruments. Pure culture techniques (Pour plate, Spreading, Streaking and serial dilution);

Unit III: Microscopy and Spectroscopy **No. of Hours: 07**

Concept of magnification, resolution and contrast in microscopy, Introduction to Microscope, Principle, types and application of Light and Electron Microscopy, Foldscope, Beer-Lambart law and its application in Spectrophotometry.

Unit IV: Stains and staining techniques **No. of Hours: 07**

Theories of staining, Mechanism of gram staining; Stain vs dye, Principle and applications of staining techniques: simple stain, differential stain, negative stain, endospore stain, and acid-fast stain.

Semester- II
Microbiology- MD/ID
Name of paper: Techniques in Microbiology

TOTAL HOURS: 60 **CREDITS: 02**

1. Demonstration of autoclaving process
2. Preparation of solid and liquid media.
3. Enumeration of total viable count in water/soil sample.
4. Isolation of pure culture of bacteria.
5. Gram staining of bacterial cell.
6. Demonstration of working of UV-Visible spectrophotometer

Suggested Readings

- Wiley, J.M., Sherwood, L.M. and Woolverton, C.J. Prescott, Harley and Klein's microbiology. McGraw-Hill, New York.
- Keith Wilson And John Walker (Editors) Principles and Techniques of Biochemistry and Molecular Biology Seventh edition. Cambridge University Press.
- Pelczar, M.J., Chan, E.C.S. and Kreig, N.R. Microbiology. McGraw-Hill, New York.
- Cappucino, J. and Sherman, N. Microbiology: A laboratory manual. Benjamin/Cummings Publishing Company, San Francisco.

SEC II: MICROBIAL DIAGNOSIS IN HEALTH CLINICS

TOTAL HOURS: 30 CREDITS: 02

Unit I: Importance of Diagnosis of Diseases **No of Hours: 04**

Bacterial, viral, fungal and protozoan diseases of various human body systems; Disease associated clinical samples for diagnosis.

Unit II: Collection of Clinical Samples **No of Hours: 10**

Procedure of collection of clinical samples (Oral cavity, throat, skin, blood, CSF, urine and faeces) and precautions required; Method of transport of clinical samples to laboratory and storage.

Unit III: Direct Microscopic Examination and Culture **No of Hours: 06**

Examination of sample by staining: Gram staining, Ziehl-Neelson staining for tuberculosis, Giemsa-stained thin blood film for malaria; Preparation and use of culture media - Blood agar, Chocolate agar, Lowenstein-Jensen medium, MacConkey agar; Distinct colony properties of various bacterial pathogens.

Unit IV: Serological and Molecular Methods **No of Hours: 10**

Serological methods: Agglutination, ELISA, Immunofluorescence; Nucleic acid-based methods: PCR, Nucleic acid probes; Kits for rapid detection of typhoid, dengue and HIV, Swine flu.

Suggested Readings

1. Ananthanarayan, R. and Paniker, C.K.J. (2009). Textbook of microbiology. University Press Pvt. Ltd., 8th ed.
2. Brooks, G.F., Carroll, K.C., Butel, J.S., Morse, S.A. and Mietzner, T.A. (2013). Jawetz, Melnick and Adelberg's Medical microbiology. McGraw Hill Publication, 26th ed.
3. Randhawa, V.S., Mehta, G. and Sharma, K.B. (2009). Practicals and viva in medical microbiology. Elsevier India Pvt. Ltd., 2nd ed.
4. Tille, P. (2013). Bailey's and Scott's Diagnostic microbiology. Mosby, St. Louis, 13th ed.
5. Collee, J.G., Fraser, A.G., Marmion, B.P. and Simmons, A. (2007). Mackie and Mccartney Practical medical microbiology. Elsevier Publishers, 14th ed.